PATENT SPECIFICATION

DRAWINGS ATTACHED

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International Classification:—**F05c. H02f, k.**

COMPLETE SPECIFICATION

Improvements relating to Submersible Pump Units

We, SUMO PUMPS LIMITED, of Crawley, Sussex, a Company incorporated under the laws of Great Britain, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns improvements relating to submersible pump units and seeks to provide a unit which, although simple and inexpensive to produce, has a relatively high output per unit of volume occupied. Borehole pump units present the problem of introducing an impeller of as large a diameter as possible within the confines permitted by the borehole in order to obtain as high a head per stage as possible and to reduce the number of stages necessary to produce a required pumping head.

According to the invention, in a submersible pump unit, the electric motor is disposed above the pump with the rotating components, namely the rotor of the motor and the impellers of the pump, supported by a sationary shaft in the form of a central tie rod holding the assembly together. With this arrangement, the cables leading to the motor do not then have to be carried past the pump, so that the diameters of the pump casing and impeller do not have to be reduced to permit this.

The rotary elements may be so mounted by way of a tubular member or members embracing the shaft and constituting bearings. The rod may be prestressed so that it remains under tension. With this simple arrangement, difficulties which can arise with a long thin rotary shaft are avoided. The shaft remains straight and its deflection small.

The ends of the shaft are screwed into end members engaging the upper end of the stator and the lower end of the impeller casing respectively. The shaft may have enlargements over which the tubular bearing member or members fit.

A convenient arrangement is illustrated by way of example in the accompanying drawing, in which:—

Figure 1 is a partial axial vertical section through the unit,

Figure 2 is a plan view of the rotor of the motor of the unit,

Figure 3 is a plan view of an upper mounting for the shaft of the unit, and

Figures 4 and 5 are detail views illustrating two stages in the making of connections to the motor tails.

In the convenient arrangement illustrated, the rotor 1 of the motor and the impeller 2 of the pump are mounted to rotate on tubular bearing members 3, 4 embracing and supported by a single stationary shaft 5 which serves as a central tie rod holding the motor and pump elements together. The shaft 5 is prestressed so that it remains under tension. With this simple arrangement, difficulties which can arise with a long thin rotary shaft are avoided. The shaft remains straight and its deflection small. The ends of the shaft 5 are screwed into a nut 6 forming part of a spider mounting 8 at the upper end a nut 7 engaging a closure 9 at the lower end of the impeller casing 10 respectively. The shaft 5 has enlargements 11, 12, 13 over which the tubular bearing members 3, 4 fit.

Individual impeller elements 14 are connected one to another by a sequence of dog engagements 15 and are finally driven by dogs 16 from the rotor 1 of the motor. Passage of the liquid past the rotor is provided for by giving the latter a shell-type of construction with helical ducts 17 extending through it. For the sake of simplicity, these ducts are shown straight in the drawing. The ducts 17

may also contribute to the pumping action of the unit.

Advantageously, the rotor 1 (Figure 2) is of the die cast type, its supporting spider, conductor bars 18 and short-circuiting end rings being formed, around the iron laminations, in one die-casting operation. The conducting metal cast around the laminations may be aluminium alloy. The laminated stator 19 has winding slots which are completely embraced on the inner, or tunnel side, and are open at the outside. The windings 20 can then readily be inserted from the outside and the magnetic circuit completed by winding iron wire 21 around the outside in the general form of a bobbin. The stator is encapsulated with insulating material 22 to produce a simple solid form and to protect the windings against water. Additional protection may be afforded by an outside layer of glass tape or similar material. The encapsulated stator 19 is held to the impeller casing 10 by an end closure piece 30 screwed by a hub 31 on to the upper extremity of the shaft 5. Delivery takes place by way of a pipe connected to a spigot 32. Connections to the motor are each made by a ferrule 23 (Figure 4) clenched over the conductors 23^1 and a watertight joint is completed by a neoprene sleeve 24 cemented to one wire 25, rolled over the joint and taped at 26 onto the second wire 27 (Figure 5). As the encapsulated stator 19 will be in compression, there is no need for any further metal or other external casing.

To avoid the necessity for a thrust bearing, the rotor 1 may be arranged below its magnetic centre, so that the centralising effect of the magnetic field will reduce the downward thrust due to the weight of the rotor. The individually by allowing the lower face of each float on the tubular bearing member 4 and the downward thrusts associated with them and their pumping action may be dealt with individually by allowing the lower face of each impeller element 14 to ride on the upper face of each diffuser stage casing or guide-vane housing 28, so that they provide their own thrust bearings without additional provision having to be made.

The elements 14 and 28 may be made of a plastic material, for example of the nylon, polystyrene or dylan type, whereby inexpensive production, light weight and non-corroding and good bearing qualities can be obtained.

The closure member 9 of the impeller casing 10, in addition to forming a clamping member for the whole assembly is perforated to form a strainer and thus prevent harmful solids from being drawn into the pump. As shown, two such members 9, 9^1 are disposed back to back and used to enclose a charge 29 of selected filtering material, such as gravel, for reducing the intake of destructive sands which might be present in some bore-holes.

WHAT WE CLAIM IS:—

1. A submersible pump unit, wherein the electric motor driving the pump is disposed above the pump with the rotating components, namely the rotor of the motor and the impellers of the pump, supported by a stationary shaft in the form of a central tie rod holding the assembly together.

2. A pump unit according to claim 1, wherein the rotary motor and pump elements are mounted by way of a tubular member or members embracing the shaft and constituting bearings.

3. A pump unit according to claim 1 or 2, wherein the rod is prestressed so that it remains under tension.

4. A pump unit according to any one of claims 1 to 3, wherein the ends of the shaft are screwed into end members engaging the upper end of the stator and the lower end of the impeller casing respectively.

5. A pump unit according to any one of claims 1 to 4, wherein the shaft has enlargements over which the tubular bearing member or members fit.

6. A pump unit according to any one of claims 1 to 5 wherein individual impeller elements are connected one to another by a sequence of dog engagements and are finally dog-driven from the rotor of the motor.

7. A pump unit according to any one of claims 1 to 6, wherein passage of the liquid past the rotor is provided for by giving the latter a shell-type of construction with helical ducts extending through it.

8. A pump unit according to any one of claims 1 to 7, wherein the stator, which is laminated, has winding slots which are completely embraced on the inner, or tunnel side, and are open at the outside, the windings being inserted from the outside and the magnetic circuit completed by winding iron wire around the outside in the general form of a bobbin.

9. A pump unit according to any one of claims 1 to 8, wherein the rotor is arranged below its magnetic centre, so that the centralizing effect of the magnetic field will reduce the downward thrust due to the weight of the rotor.

10. A pump unit according to any one of claims 2 to 9, wherein the individual impeller units are free to float on the tubular bearing members and the downward thrusts associated with them and their pumping action is dealt with individually by allowing the lower face of each impeller element to ride on the upper face of each stage casing or guide-vane housing, so that they provide their own thrust bearings without additional provision having to be made.

11. The submersible pump unit constructed and arranged substantially as hereinbefore described and as illustrated by the accompanying drawing.

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PROVISIONAL SPECIFICATION

Improvements relating to Submersible Pump Units

We, SUMO PUMPS LIMITED, of Crawley, Sussex, a Company incorporated under the laws of Great Britain, do hereby declare this invention to be described in the following statement:—

This invention concerns improvements relating to submersible pump units and seeks to provide a unit which, although simple and inexpensive to produce has a relatively high output per unit of volume occupied. Borehole pump units present the problem of introducing an impeller of as large a diameter as possible within the confines permitted by the borehole in order to obtain as high a head per stage as possible and to reduce the number of stages necessary to produce a required pumping head.

According to the invention, in a submersible pump unit, the motor is disposed above the pump. The cables leading to the motor do not then have to be carried past the pump, so that the diameters of the pump casing and impeller do not have to be reduced to permit this.

Preferably, the rotor of the motor and the impeller of the pump are mounted to rotate on bearings supported by a single stationary shaft which serves as a central tie rod holding the rotary motor and pump elements together. The said elements may be so mounted by way of a tubular member or members embracing the shaft and constituting bearings. The rod may be prestressed so that it remains under tension. With this simple arrangement, difficulties which can arise with a long thin rotary shaft are avoided. The shaft remains straight and its deflection small.

The ends of the shaft are screwed into end members engaging the upper end of the stator and the lower end of the impeller casing respectively. The shaft may have enlargements over which the tubular bearing member or members fit.

In a convenient arrangement, the individual impeller elements are connected one to another by a sequence of dog engagements and are finally dog-driven from the rotor of the motor. Passage of the liquid past the said rotor is provided for by giving the latter a shell-type of construction with helical ducts extending through it. These ducts may also contribute to the pumping action of the unit.

Advantageously, the rotor is of aluminium and is die-cast on the conductors. The laminated stator may have winding slots which are completely embraced on the inner, or tunnel side, and are open at the outside. The windings can then readily be inserted from the outside and the magnetic circuit completed by winding iron wire around the outside in the general form of a bobbin.

The stator may be encapsulated with insulating material to produce a simple solid form and to protect the windings against water. Additional protection may be afforded by an outside layer of glass tape or similar material. Connections to the motor tails may be made by a ferrule clenched over the wires and the watertight joint effected by a neoprene sleeve cemented to one wire, rolled over the joint and taped onto the second wire. As the encapsulated stator will be in compression, there is no need for any further metal or other external casing.

To avoid the necessity for a thrust bearing, the rotor may be arranged below its magnetic centre, so that the centralizing effect of the magnetic field will reduce the downward thrust due to the weight of the rotor. The individual impeller elements may be free to float on the tubular bearing members and the downward thrusts associated with them and their pumping action may be dealt with individually by allowing the lower face of each impeller element to ride on the upper face of each stage casing or guide-vane housing, so that they provide their own thrust bearings without additional provision having to be made.

The impeller elements and the diffusers or guide-vanes may be made of a plastic material, for example of the nylon, polystyrene or dylan type, whereby inexpensive production, light weight and non-corroding and good bearing qualities can be obtained.

The lowermost member of the impeller casing, in addition to forming a clamping member for the whole assembly may be perforated to form a strainer and thus prevent harmful solids from being drawn into the pump. Two such members may be disposed back to back and used to enclose a charge of selected filtering material, such as gravel, for reducing the intake of destructive sands which might be present in some boreholes.

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903,981 COMPLETE SPECIFICATION

1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

FIG.1

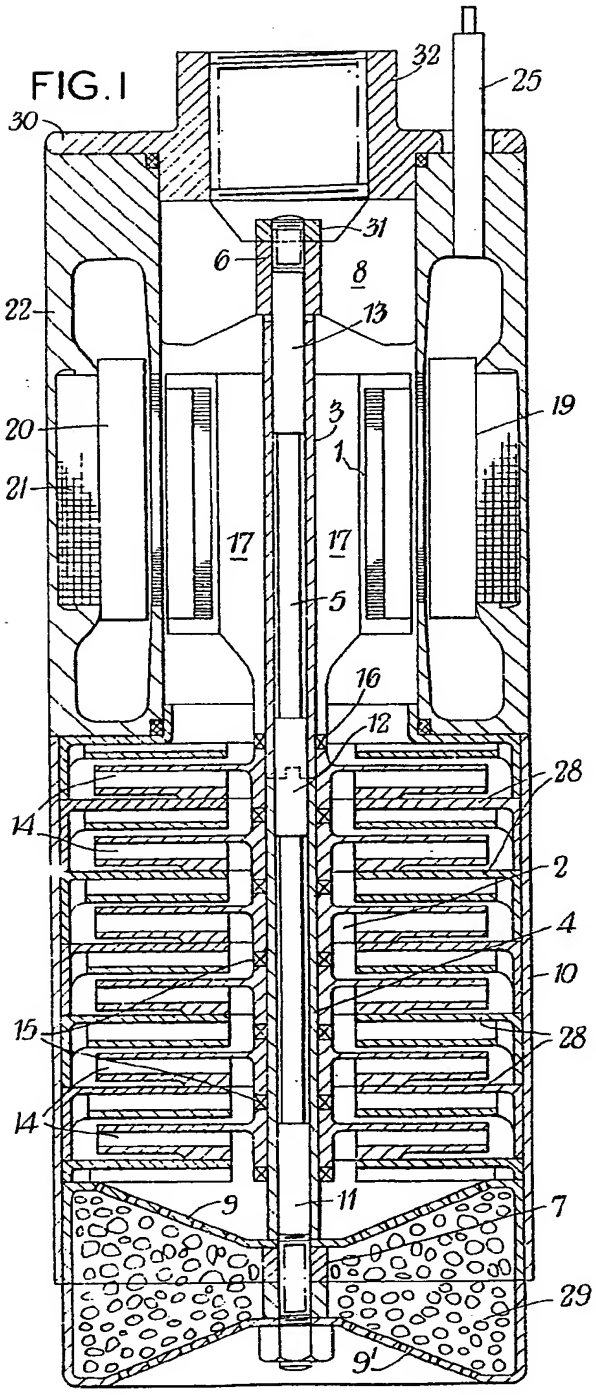

FIG.3

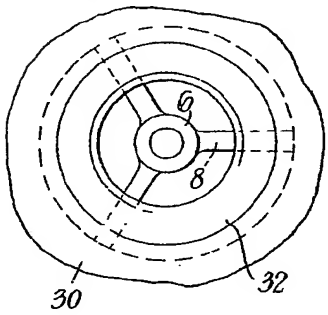

FIG.2

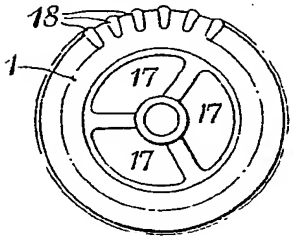

FIG.5

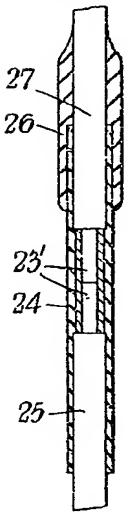

FIG.4